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Eastern Pacific Expeditions of the New York Zoological Society. XXX.

Atlantic and Pacific Fishes of the Genus *Dixonina*.¹

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(Plates I & II).

[This is the thirtieth of a series of papers dealing with collections of the Eastern Pacific Expeditions of the New York Zoological Society made under the direction of William Beebe. The present paper is concerned with specimens taken on the Eastern Pacific *Zaca* Expedition (1937-1938). For data on localities and dates of this expedition, refer to *Zoologica*, Vol. XXIII, No. 14, pp. 287-298.]

In connection with studies of differentiation or of identity in species of fish from opposite sides of North and Central America, I have reviewed the data on *Dixonina*. This consists of the published account by Fowler, of the type of *Dixonina nemoptera*, taken many years ago at Santo Domingo, West Indies, and of the second known Atlantic specimen by Metzelaar, from Puerto Cabello, Venezuela (*not Curacao*, as recorded by Dr. Myers.).

As regards Pacific records of *Dixonina*, Dr. George S. Myers, in 1936, searched the collections of the United States National Museum. He found a single individual of fifteen inches standard length, which long before had been acquired by the Museum, with no data except the locality Acapulco, Mexico. No description was published.

In the Japanese publication "Marine Fishes of the Pacific Coast of Mexico," 1937, with text by Yosio Hiyama, we are told in the preface that all the fish mentioned were collected in 1935-1936 on the trial fishing trip of a Japanese boat, and all taken by trawling. There are four lines of text on page 27 which refer very evidently to *Albula*, with the note that this species was "abundant in the Gulf of California." We

find, however, the single sentence, "in some specimens the last rays of dorsal elongated." In agreement with this, Plate Five presents an excellent colored figure of *Dixonina*, both as to correct relative length of the maxillary, number of lateral line scales and in the two elongate fin rays. So we must recognize this as the second Pacific published record of this species. The length of this specimen seems to have been 270 mm.

Along the northern part of the Pacific coast of Costa Rica, on the Eastern Pacific *Zaca* Expedition of the Department of Tropical Research, we rediscovered, in 1938, this interesting relation of the bonefish. At three places along a stretch of shore of about seventy-five miles we took a total of 19 *Dixonina*, both in seines and by hand line from the *Zaca*, the fish measuring from 80 to 365 mm. standard lengths.

The two Atlantic specimens measure 381 and 260 mm. standard lengths respectively. With the published data of these I have compared two of my Pacific *Dixonina*, one of 352 and the other 365 mm., and the accompanying table gives the comparative results. In the same table are corresponding characters of two additional Pacific *Dixonina*, of 185 and 80 mm. standard lengths.

Dixonina pacifica sp. nov.

Type: Holotype, No. 26,131, Eastern Pacific *Zaca* Expedition of the Department of Tropical Research, New York Zoological Society; Port Culebra, Costa Rica (No. Lat. 10°31'; West Long. 85°40'): caught on hand line from the *Zaca*, January 24, 1938; standard length 352 mm.; adult female in full breeding condition. Type in the collections of the Department of Tropical Research, New York Zoological Society.

¹ Contribution No. 636, Department of Tropical Research, New York Zoological Society.

Diagnosis: The distinction between the Pacific *Dixonina pacifica* and the Atlantic *Dixonina nemoptera* is as follows. In the former there is a greater number of lateral line scales (81 to 84, as compared with 76); increased number of vertical lines of scales on dorsal half (11, not 9), and on ventral half (9, not 7); decrease in predorsal scales (22 instead of 30); smaller eye (6.8 to 7, not 4.15); longer pelvic fins (2.2 and not 2.7); greater number of gill-rakers (7 + 11 instead of 4 + 9).

Identical characters in *Dixonina* from the two oceans are, relative head length, depth, snout, maxillary, lengths of the first and last dorsal rays and the last anal ray, pectoral length, branchiostegals, and apparently fin counts, although as regards those of the dorsal and anal there is considerable confusion.

Measurements and Counts: Standard length 352 mm.; depth 80; head 120; eye 17; snout 44; maxillary 54; interorbital 18; pectoral length 54; pelvic length 54; snout to dorsal 195; snout to anal 330; snout to pectoral 117; snout to pelvic 247; dorsal height 60; last dorsal ray length 62; anal height 32; last anal ray length 40 mm.; dorsal fin count II, 20; anal fin count I, 9; pectoral count I, 16; pelvic count I, 10; gill-rakers 7-11; branchiostegals 14; lateral line scales 81; scale rows dorsal to lateral line 11; lateral line to anal 9.

Range: Northeastern Pacific coast Mexico: (Gulf of California and Acapulco); Costa Rica: (Potrero Grande, Port Culebra and Piedra Blanca Bays).

Field Characters: An elongate, spindle-shaped fish of the eastern Pacific coast, with conical snout overhanging the mouth; maxillary longer than snout; last ray of dorsal and of anal fin produced into a long filament; shining silver with dark scale lines along upper half of body. More than 80 lateral line scales.

Color: Brilliant silver, appearing dark above in certain lights with dark green on the head; this dorsal pigmentation resolves into eight very dark lines along each side of the upper half of the body, covering about one-fourth of each scale nearest to the adjoining line. Dorsal fin greenish, caudal dusky, anal silvery at base; a dusky spot at pectoral base, with yellow spot behind; basal membrane of pectoral apple green, rest of fin dusky. These colors fade at death. Iris silvery.

In the young fish, at least up to 90 mm. in length, two rows of dark spots extend along the side of the body, the upper close to the mid-back. In a 115 mm. fish the spots are less conspicuous and the dorsal dark lines begin to be distinct. The spots persist after death. In the full-grown fish the dark scale lines are fainter than in fish of medium size.

Size: The largest recorded fish is that in the U. S. National Museum collection, "a fine 15-inch adult," (381 mm.).

Local Distribution: Wherever we found these fish, they inhabited the same coastal shallows, off sand or muddy shores, as *Albula*.

Abundance: Common wherever found; twelve taken in one seine haul, and three and two on successive days with hand lines.

Food: A 90 mm. fish (28,051 b) taken at Potrero Grande, Costa Rica, had in its stomach 1 mysid, 1 shrimp and 1 euphausid, all small. The food of another fish of 179 mm. from the same locality was an *Atherina* sp. of 40 mm. and an 80 mm. *Anchoviella* sp. The fully adult female (26,131) had, in its intestine, remains of a small fish and a small anomuran crustacean. In the stomach proper was a freshly swallowed and quite undamaged *Squilla hancocki*, the fifth known specimen.

Breeding: The type, specimen Number 26,131, standard length 352 mm. was taken by hand line from the *Zaca* in Port Culebra, Costa Rica, January 24, 1938. It proved to be a full-grown female with ovaries well developed. The eggs seem almost ready for deposition. The two ovaries are large, wrapped about the stomach and intestine, fairly thick down the mid-dorsal line of the coelom, and thinning out into sheets or wings around the caeca and stomach, almost meeting ventrally. They are 170 mm. in length and 30 mm. at their widest extent around the caeca. They weigh together 45 grams, and a carefully estimated count, based on divisional weight, works out at about 70,000 eggs. Individual eggs measure .35 to .45 mm. in diameter.

Study Material: 19 specimens. Costa Rica: Potrero Grande, 11 transitional adolescents (28,051, a, b, c, d, e; 26,046, a, b, c, d, e, f), 80-200 mm., 3 of which were in the immature spotted stage, seine; and 3 additional adolescents (26,123, 26,124 and 26,125), 220-270 mm., taken on hand line from *Zaca*, January 23, 1938. Culebra Bay, 2 adults (26,131, and one 26,131 a, lost after description), 352 and 365 mm., January 24, 1938, on hand line from *Zaca*; Piedra Blanca, 3 transitional adolescents (28,746 a, b, c), 80, 110 and 115 mm., all in spotted phase, February 2, 1938, seine.

References: *Dixonina nemoptera*, Myers, G. S. *Copeia*, 1936: 83-85 (Announcement of discovery of a Pacific *Dixonina* in the collections of the U. S. National Museum, labelled Acapulco).

Albula vulpes (in part) Kumada & Hiyama, Marine Fishes Pacific Coast of Mexico, 1937: 27, Plate 5 (short description, referring in part to *Dixonina*; Gulf of California, plate of *Dixonina*).

TABLE 1.

Comparison of proportions and counts of Atlantic *Dixonina nemoptera* and Pacific *Dixonina pacifica*.

	Atlantic		Pacific			
Standard length	381	260	352	365	185	80 mm.
Head length	109	108	120	115	52	23 mm.
Head (in length)	3.5	2.4	2.9	3.1	3.5	3.9
Depth (in length)	4.6		4.4	5	5	6.6
Dorsal fin	V, 16, I	19, I	II, 20		II, 20	II, 20
Anal fin	III, 6, I	7, I	I, 9		I, 9	I, 9
Pectoral fin	I, 16		I, 16		I, 16	I, 16
Pelvic fin	I, 8		I, 10		I, 10	I, 10
L.1. scales	76	76	81	84	84	80
Dorsal to L.1.	9	9	11	11	11	10
Anal to L.1.	7	7	9	9	9	9
Predorsal scales	30		22	22	23	23
Snout (in head)	2.6	2.5	2.7	2.6	2.6	2.7
Eye	5.6	5	7	6.8	5.7	4.6
Maxillary	2	2.1	2.2	2.1	2.2	2.1
Interorbital	4.15		6.6	5.1	4.7	
1st dorsal ray	1.8	1.9	2	1.8	1.8	
Last dorsal ray	1.7		1.9	1.5	2.6	5.3
Last anal ray	3.25		3		3.2	6
Pectoral length	2		2.2		2	2.1
Pelvic length	2.7		2.2		2.3	2.6
Gill-rakers	4+9		7+11	7+11	7+11	7+11
Branchiostegals	14		14		12	
Vertebrae					77	

ONTOGENETIC CHANGES.

The following are the ontogenetic changes apparent in this species, based on three individuals, a small transitional adolescent in the immature spotted phase of 80 mm., a late striped adolescent of 185 mm., and a fully breeding adult measuring 352 mm. in standard length.

The head increases slightly in comparison with the length, from young to adult, 3.9 times to 2.9; a corresponding change in depth is more marked, the increase being from 6.6 times to 4.4; The median fin count remains the same at all ages, although hints of two additional anterior spines in the anal were detected in a cleared 110 mm. adolescent; also in the same fish the pectoral count was distinctly increased to I,18 instead of the usual I,16, and the pelvic showed I,11 elements instead of the more typical I,10. The eye decreases relatively with age, measuring 4.6 times in the head in the youngest, as compared with 7 times in the oldest. The elongate last dorsal and anal rays increase markedly with age, the former changing from 5.3 to 1.9 times in the smallest and largest fish, and the anal filament from 6 to 3 times in the head. Ontogenetic changes in other characters are negligible.

MEDIAN FINS.

In regard to the moot question of whether the last two, closely associated rays of the dorsal and the anal fins should be counted as one, as one and a half, or as two seems to me to reduce itself automatically to a ques-

tion either of the recognition of natural evolution or of personal preference. My choice is to consider them as two rays.

In addition to any phylogenetic interest expressed in the elongated posterior ray of the median fins, it is an important differential generic character. It is also singularly persistent, although appearing sporadically in several genera of Isospondyli, such as *Tarpon*, *Dixonina*, *Dorosoma*, *Signalosa*, *Opisthonema* and *Chanos*. Thus if we should consider the posterior, closely-associated rays as one, we should have to describe the elongated character as formed by one-half of the posterior ray.

Judging by many metameral characters of these and other fish, and by general evolutionary knowledge, we know that phylogenetically, and often ontogenetically, such structures usually decrease in serial number. In the present case, we can be quite sure that the close association of the two posterior rays of the median fins is due to a comparatively recent reduction, and that at one time both were wholly separate as to subdermal elements. The same thing holds in the case of the present, intimately associated, but clearly distinguishable anterior spine or spines.

As these spines, present in both dorsal and anal fins, are extremely hard, and wholly lack the nodes or segments characterizing all rays, we must omit the conventional "Isospondyli—Dorsal and anal without true spines."

In my discussion of the supporting bones of the median fins, instead of using the

cumbrous "proximal or distal interspinous bones," or "Pterygiophores", or "inter-neural and interhaemal bones", I am making use of Jordan's terms, *baseosts* and *axonosts*, which seem simple and self-explanatory.

ANAL FIN.

Based chiefly on a 185 mm. specimen, No. 28,046 b. With a few references to a 170 mm. fish (28,046 a), and to a 110 mm. fish (28,746).

The normal count of the anal fin in this species, both in fully adult breeding individuals, and in transitional adolescents from 200 down to 80 mm. standard lengths, is 1-9. In one specimen of 110 mm., however, I have found distinct traces of two minute spines anterior to the definite one which we count as I. No separate axonosts exist for the anterior four elements (the spine and three rays), although the anterior one flares out in a curved, double wing, and a distinct seam indicates that they, the next two, are fused together and to the distal head of the compound baseost. The first three baseosts (belonging to the spine and two rays) are fused at their distal ends, the second and third fanning out and forming the anterior and posterior edges of a large, thin, longitudinally oriented, bony wing or fan.

The 1st baseost (serving the spine) is a minute, bony nubbin (.8 mm.), attached to the anterior, distal portion of the 2nd baseost. The small hard spine (2.3 mm.) is closely applied to the anterior surface of the 1st ray. The 2nd baseost (2.5 mm.) forms the anterior border of the above-mentioned wing or fan; its ray is 6.5 mm. long. The 3rd baseost (6.5 mm.) forms the posterior border of the wing, and its ray which is the first branched one, is 14 mm. The 4th baseost is like all the succeeding ones, but its axonost is absent, the 4th ray articulating directly with the end of the baseost.

From here back, we find five baseosts, long, slender, but rather blunt, each fringed, fore and aft, by a fin or wing of thin bone. Each fin almost touches the one in front and that behind, so there can be extremely little inter-baseost movement, even if the muscular tissues permitted. Each baseost points sharply forward, the two last being even more acutely oblique, thus bringing the three posterior proximal tips close together. Each baseost articulates closely with its axonost. These are saddle-shaped, and each is partly covered with the pair of large, blunt spines which extends down and out from near the base of the rays.

The 8th ray, while furnished with normal axonost and baseost, is placed somewhat above the level of the rest of the rays, and its articular surface is at a greater distance from the corresponding surface of the axonost.

The 9th or last ray, the elongated one, ends basally in two, long, slender, curved spines which extend down toward, but do not quite bestride, the last axonost. This is almost double the size of the rest, and in all nearly grown or adult fish completely lacks a baseost. In a 110 mm. *Dixonina*, however, a faint, cartilaginous one is visible, one-third as long as the others. In this individual, too, both of the last two rays are elongate, and share equally in this generic character. They measure 7 mm. in length, compared with 4.3 mm. of the 7th ray.

The inter-rayal webbing is extremely delicate and is easily destroyed. From each side of each ray there arises a flap or narrow, vertical curtain of scales, attached only along the side, and hanging freely behind, about twice or three times as wide as the ray stem itself. Thus each ray possesses a web connecting it with the succeeding ray, and in addition, two longitudinal scale flaps which lie flat against the web, but can be lifted up at right angles and replaced again. The two posterior rays are wholly free from these scales, but the ray in front (7th in the anal) has three scales in a vertical line, forming its flap, and this number increases to a dozen or more along the long, anterior rays.

DORSAL FIN.

The count of the dorsal fin is consistent in both adult and young *Dixonina pacifica*, II-20. Except for its extra spine and nine additional rays, the dorsal fin is a replica of the description I have given of the anal fin.

In a 185 mm. fish the lengths of the elements are as follows: First spine, very small (1.5 mm.); 2nd spine 2.3 mm.; 1st ray, 6 mm.; 2nd ray, 12.3 mm.; 3rd ray, 21.3 mm.; 4th, or first branched ray, 28.6 mm.; 19th ray, 6.7 mm.; and 20th or elongate ray, 19.3 mm. in length.

GILL-ARCHES.

For gill-arch comparison I have chosen three individual fish, of 80, 185 and 352 mm. standard lengths, or approximately 25, 50 and 100 per cent. In the 80 mm. adolescent, the conventional gill-raker count of the first arch is 7-11, and in the 352 mm. fully adult individual it is the same, the anterior two or three on the hypobranchial being somewhat indistinct from a concentration of surrounding spinous areas. Of the rakers on the lower arch, the ceratobranchial bears 7, the hypobranchial the remaining 4. Most of the following notes have to do with these 7, as they are typical of those on all other segments.

In the smallest fish the 7 ceratobranchial rakers are the only armature on the outer side of this element, and are relatively long, straight-sided and covered solidly with long, sharp spines. Along the summit of the ridge

of this arch is a series of 6 narrow groups of spines, the profile view of the ridge resembling a jaw with wavy line of teeth. The inner side of the arch is a replica of the outer, 7-11, but with the individual rakers much smaller, and alternating with those on the outer side.

In the 185 mm. fish the rakers have become somewhat shorter and less erect, with the spines short, except those at the summit which are long and curved inward. The line of ridge spines has grown down, sending triangular areas over each side, alternating with the rakers proper. This stage is very similar to that found in the adults of some of the pike perches (*Stizostedion*).

Along the hypobranchial these form a closely interlocked pattern of alternating triangles. These almost fuse with the dental armature of the basibranchial. Along the periphery of this latter area the teeth are thick, sharp and peg-like, giving place almost at once to the rounded molars typical of the large areas of the oral cavity.

In the adult fish the rakers are short and thick, projecting only slightly above the level of the ridge, and with all the spines short. The descending areas have reached half way down the side of the arch, and below them, and between the bases of the rakers, new, small, spiniferous patches have developed. On the hypobranchial the patches are so continuous that only with difficulty can all 4 rakers be distinguished. In fact the adult arch is almost solidly covered with a spiny coat, out of which the original rakers project as low mounds.

Relative to the length of the fish, the rakers and gill-filaments are longer in the young than in the adult.

TEETH.

The teeth, as developed in an old transitional adolescent of 185 mm., are of two distinct types, first, sharp and curved ones, in rows or small clusters, but not villiform; and, second, low, blunt molar-like teeth in patches. The former are well-developed on the premaxillary and the mandible. In the young and half-grown fish they are in two distinct rows, but in the adults these become less apparent, and may merge into wider bands, 4 or 5 teeth deep. There is a slightly curved row of teeth on the vomer, which laterally merge into the narrow, elongate patches of the palatines.

In the back of the mouth, the 1st epibranchial shows only a very slight concentration into a patch, but on the 2nd, 3rd and 4th arches there are developed increasingly larger pharyngeal-epibranchial patches of teeth, all of the same type as those on the jaws. These, especially the ones on the 3rd and 4th arches, are directly opposed to the two large, triangular patches on the 5th ceratobranchials.

The molar type of teeth is segregated in mid-mouth, in three large, palatal patches, the central one on the parasphenoid, and the two lateral on the entopterygoids (not, as Fowler has them in his type description of *Dixonina nemoptera*, on the sphenoid and pterygoids). The tongue is fleshy with only the most minute rugosities. The 1st basibranchial is armed solidly with a great convex mass of the molars. The anterior half of the 3rd basibranchial is similar.

The two types of teeth are everywhere distinct in the 185 mm. fish, except on the 3rd basibranchial patch where they are intermediate, pointed, but much thicker and coarser than the jaw teeth. They are on their way to the change in the adult to the true molar type.

The opposite of this is seen in the full-grown fish, where a scattering of true molar teeth, intermediates, and typical gill-raker teeth are found intermingled, in intimate association in small patches on the hypobranchials of the 1st gill-arch. These are typical gill-raker patches, distinct from the large basibranchial molars. They seem to exhibit a distribution in reverse, secondarily outward and away from a dominant molar concentration.

Fish Number 28,051 b, a young transitional adolescent of 80 mm. has the entire edge of the premaxillaries toothed for a distance from the snout-tip back of 6.7, followed almost unbrokenly by a 2.8 mm. toothed edge of the maxillaries. On the latter there are only about twelve. The teeth on the premaxillaries and on the mandible are in two distinct rows, and distinguished by the decided divergence of the angles of direction, the first row almost straight, and those behind pointing obliquely back and into the mouth. The outer row is slightly larger and more even, but all are strongly curved and quite slender.

In front of the upper jaw, on the whole ventral surface of the snout, the skin is covered with minute but hard spicules.

The three palatal patches are fairly well defined in this young fish, rounded in outline and convex, but each tooth, although rounded, possesses a sharp point, while many of those along the outer rim of the palatines are curved and more slender, half-way between the two extremes of teeth.

About 1 mm. behind the symphysis of the upper jaw, lies the triangular vomer, its apex projecting forward, and the dentulous area confined to the posterior base. These vomerine teeth form a slightly irregular line, about 16 to 18 in all. They almost, but not quite, join on each side with the teeth of the palatines.

Adult female, No. 26,131, length 352 mm., has the premaxillaries toothed throughout, in about five rows in front, dwindling to one at posterior end. All are fairly slender,

slightly curved and sharp. All trace of teeth has gone from the edge of the maxillaries. The vomer has a straight line of teeth, slightly curved in front and containing about four rows. This area merges into the lateral palatine teeth, which form elongate areas, curved along outer outline, straight inside, four to six rows, narrowing behind to two. Teeth as in premaxillary but straighter.

Twenty-two mm. behind the vomerine teeth, begins the large, oval, median patch on the parasphenoid. This is 30 by 12 mm. On each side, also oval, but more elongate, with the inner margins almost touching the median patch, are the entopterygoid patches, 32 by 10 mm. The posterior end of the median area extends to between the second gill-arches, while the lateral patches cut into only the first arch. All three patches are decidedly convex. These teeth are molar-like, mosaics of low, smooth, rounded mounds, largest on the top of the convexities.

On the base of the tongue, covering the basibranchial, 18 mm. back of the fleshy tip, is a fourth molar patch, 9 by 16 mm., very steeply convex, sending back a narrow ridge over the center of the first arch, and ending on the third. This patch fits neatly into, and fills the space between, the three palatal patches, forming a most efficient grinding apparatus.

DIGESTIVE SYSTEM.

The oesophagus extends straight back from the pharynx for 40 mm. enlarging abruptly into the dead white stomach, a cylinder about 50 mm. long by 30 mm. in diameter. Posteriorly, this mid-section of the stomach narrows rather sharply into a long (50 mm.) tapering, blind finger. From the level of the oesophageal entrance, a large rounded diverticulum extends 35 mm. forward, with a diameter of 25 mm., lying directly over and ventral to the oesophagus. On the left side this forward extension of the stomach is exposed, its tissues distinguished by being darker than the stomach proper. Its top and entire right side, and most of the same side of the stomach as well, are covered solidly with the large, concentrically curved, white caeca. There are 15 main caeca, but 5 of these are bifurcated for one-fifth to one-half of their length. Each caecum is distinctly separated from its fellows by heavy bands of dark pigment. The attaching tissue is very slight, and the whole caecal mass readily peels away to its basal line of intestinal attachment.

From the summit of the anterior diverticulum, the intestine arises, extending straight back to the anus, a length of 145 mm., with the caeca occupying the first 60 mm. The lobes of the liver are very unequal, the left 65 by 25 mm. and the right 30 by 15 mm. The former extends around and down over the middle third of the stomach, to beyond the mid-ventral line, while the smaller lobe overlies the anterior caeca. The slight amount of fat, chiefly a linear mass along the ventral line of the caecum, is bright orange.

In a 90 mm. *Dixonina* (28,051 b) the stomach is relatively much more slender than in the adult, and the posterior blind end is not finger-like, but an undifferentiated posterior extent of the stomach, very slightly less in diameter. The caeca are 13 in number and relatively larger, both individually and in general extent. The anterior part of the stomach, the hardly distinguishable mid part and the entire posterior portion are all crammed with small mysids, shrimps and euphausiids.

ADIPOSE EYE-LID.

The adipose eye-lid was so loosely attached that a considerable number of sand grains had worked beneath it. With a little careful manipulation I got the entire mass off whole. It was attached most firmly anteriorly at the tip of the snout, below the nostril, and above the eye. In fact the anterior portion was attached while almost the whole posterior, much of the ventral and the postero-superior areas were loose.

EXPLANATION OF THE PLATES.

PLATE I.

- Fig. 1. *Dixonina pacifica*, sp. nov. Holotype, adult female, No. 26,131, Port Culebra, Costa Rica, January 24, 1938. Standard length 352 mm.
- Fig. 2. Outer right gill-arch of *Dixonina pacifica*, transitional adolescent. Standard length 80 mm.
- Fig. 3. Outer right gill-arch of *Dixonina pacifica*, transitional adolescent. Standard length 185 mm.

PLATE II.

- Fig. 4. Outer right gill arch of *Dixonina pacifica*, adult female, holotype. Standard length 352 mm.
- Fig. 5. Bend of outer right gill-arch of *Dixonina pacifica*, adult female, holotype. Standard length 352 mm.

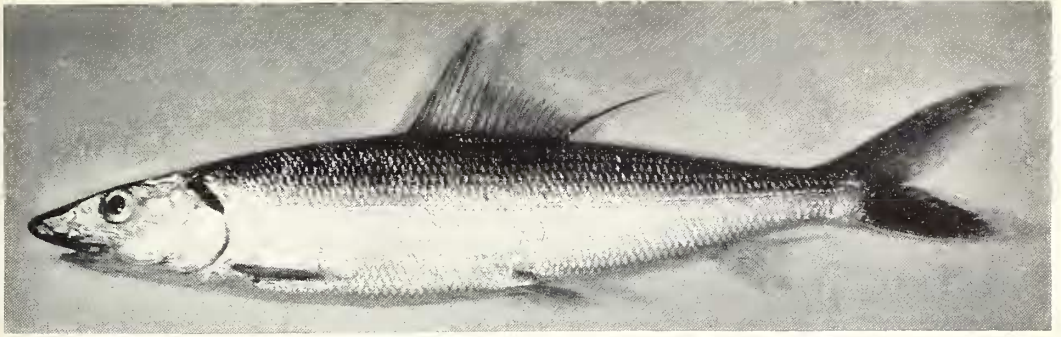


FIG. 1.

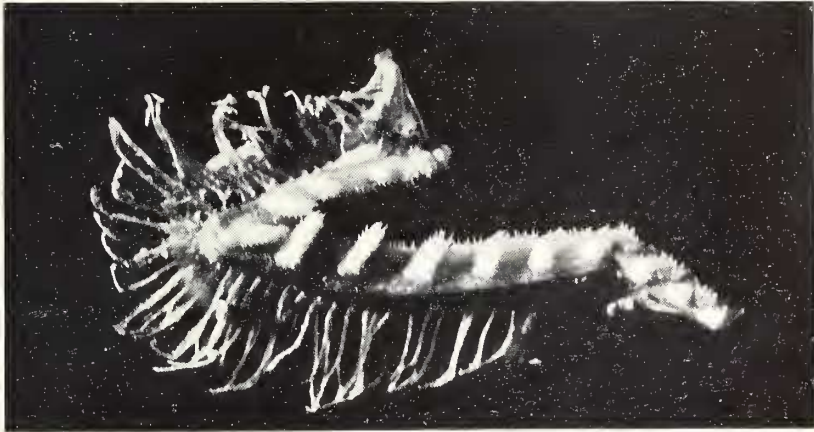


FIG. 2.



FIG. 3.

ATLANTIC AND PACIFIC FISHES OF THE GENUS *DIXONINA*.

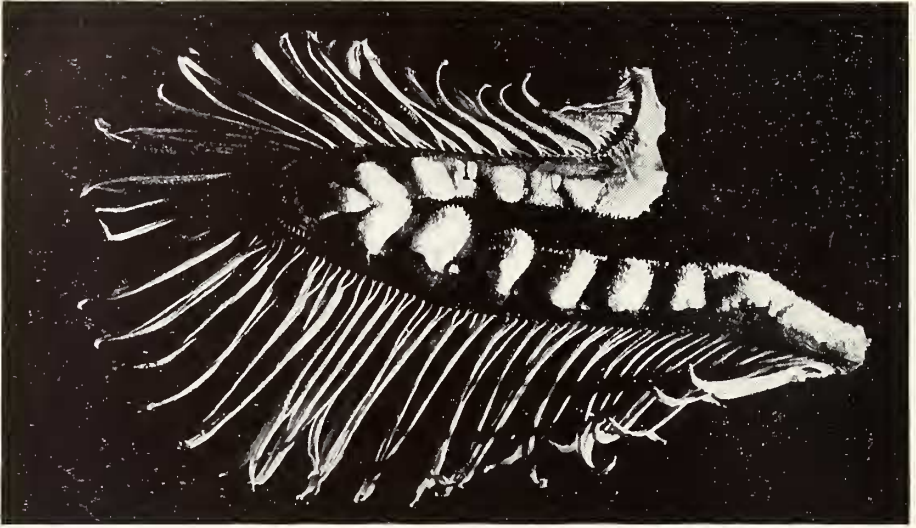


FIG. 4.

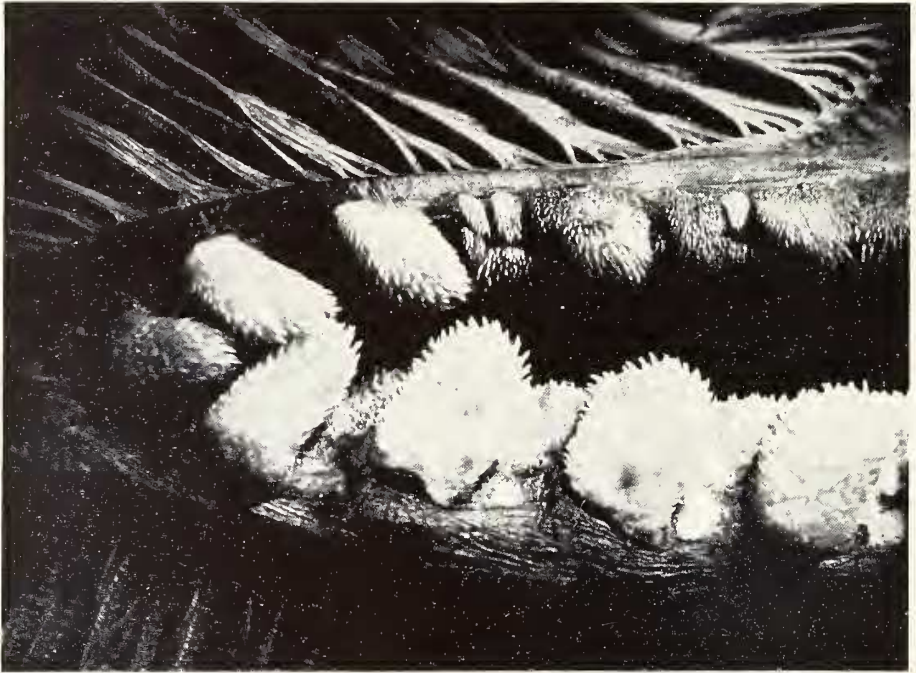


FIG. 5.

ATLANTIC AND PACIFIC FISHES OF THE GENUS *DIXONINA*.